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Multimedia Content Creation using Global Network Cameras: The Making of CAM^2

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Acknowledgments: National Science Foundation ACI-1535108, CNS-0958487, and IIP-1530914, Amazon, Microsoft, and the owners of the data. Any opinions, findings, and conclusions or recommendations expressed in this, material are those of the author and do not necessarily reflect the views of the sponsors.

Mobile Devices and Multimedia Content

Consumption

More than half of YouTube views come from mobile devices.

YouTube Statistics

Creation

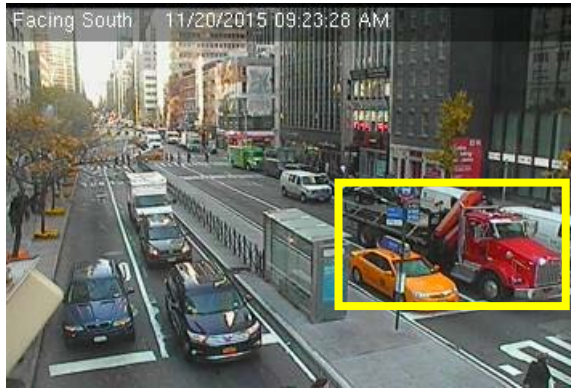
Multimedia Content Creation: Location Problem

Out-Of-Date Multimedia Content Problem

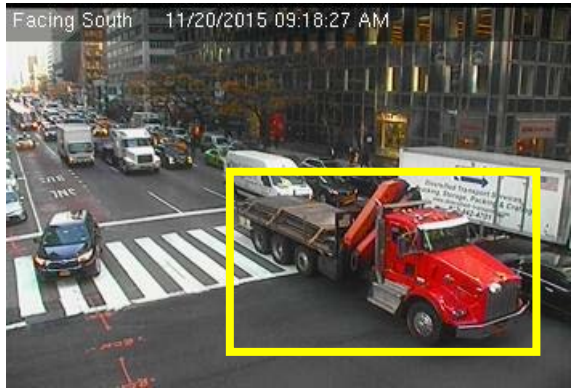
Hotel Expectation

Hotel Reality

Multimedia Content Problems


Facing South 11/20/2015 09:23:28 AM


Facing South 2015-11-20 09:20:38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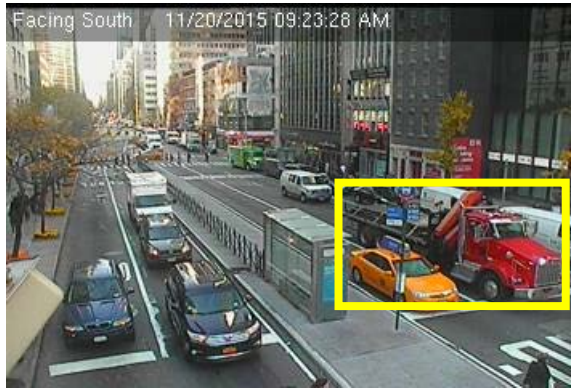
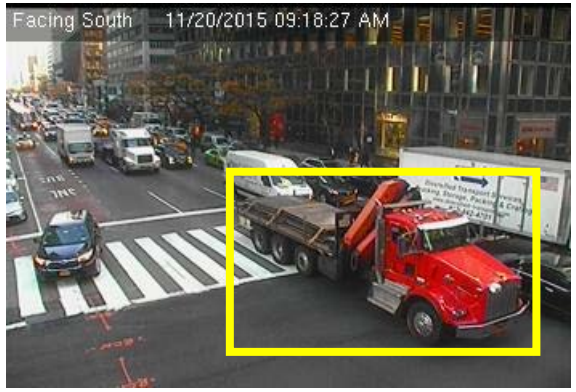
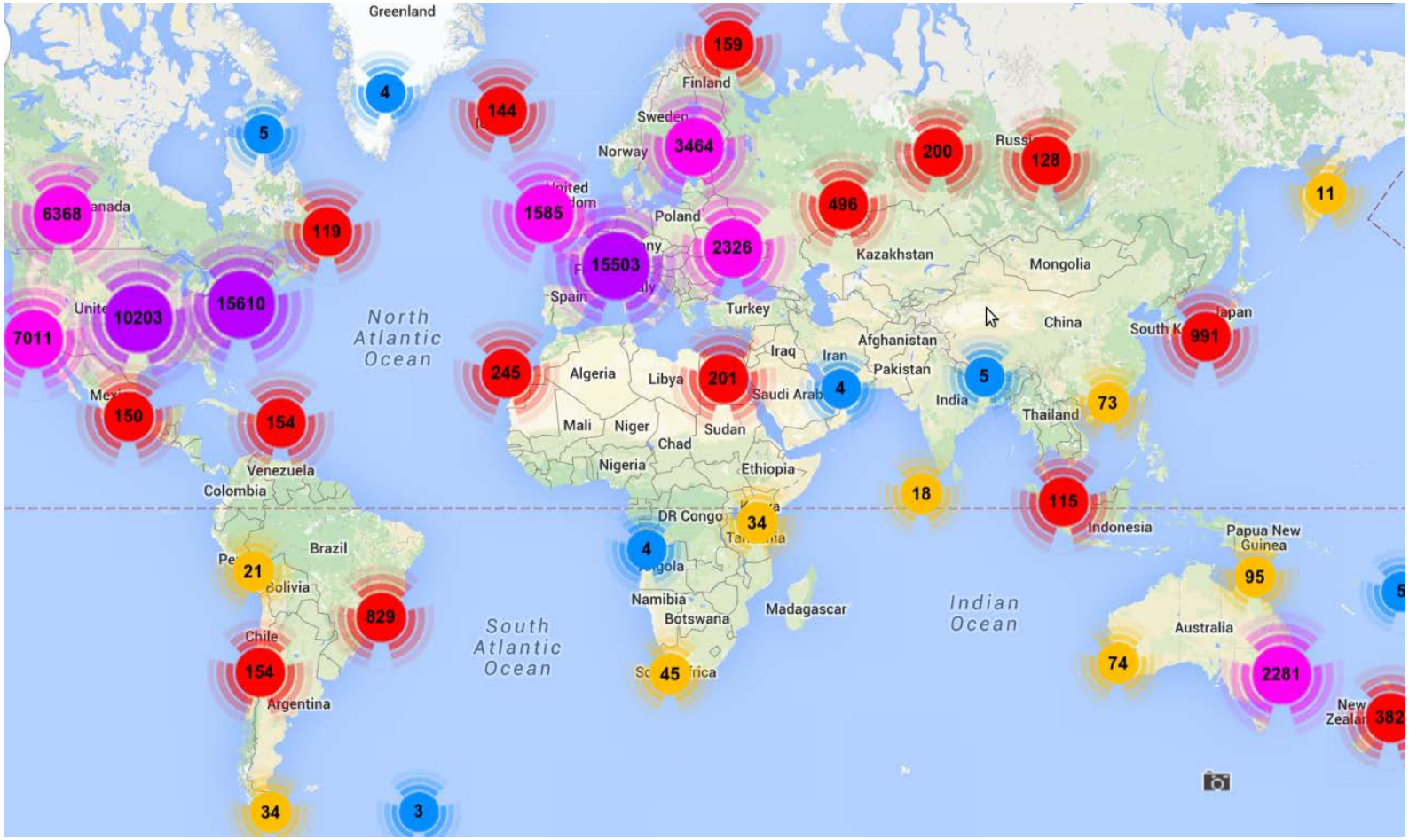
CAM²

Continuous Analysis of Many CAMeras

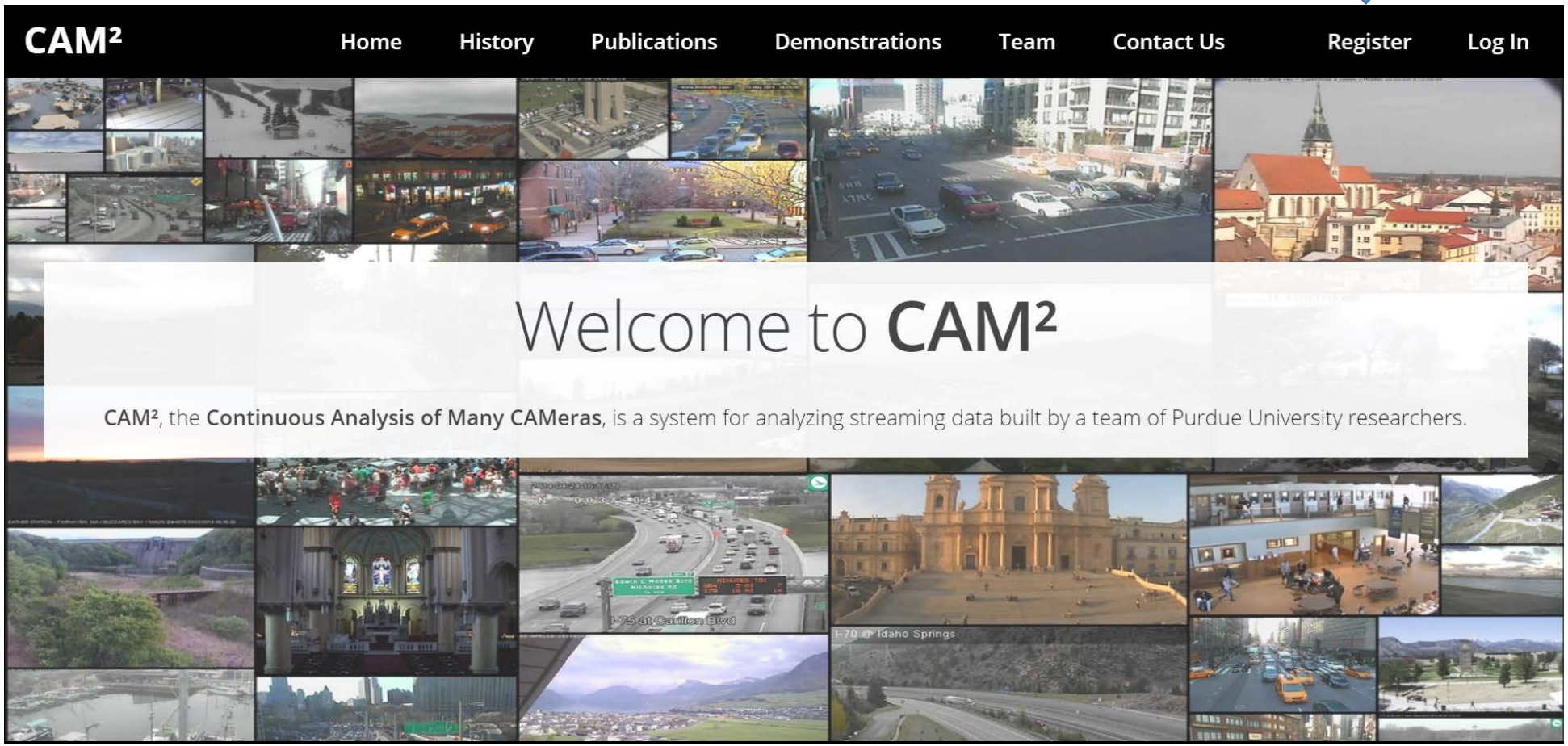




CAM^2 has more than 70,000 geo-tagged cameras.



http://cam2.ecn.purdue.edu

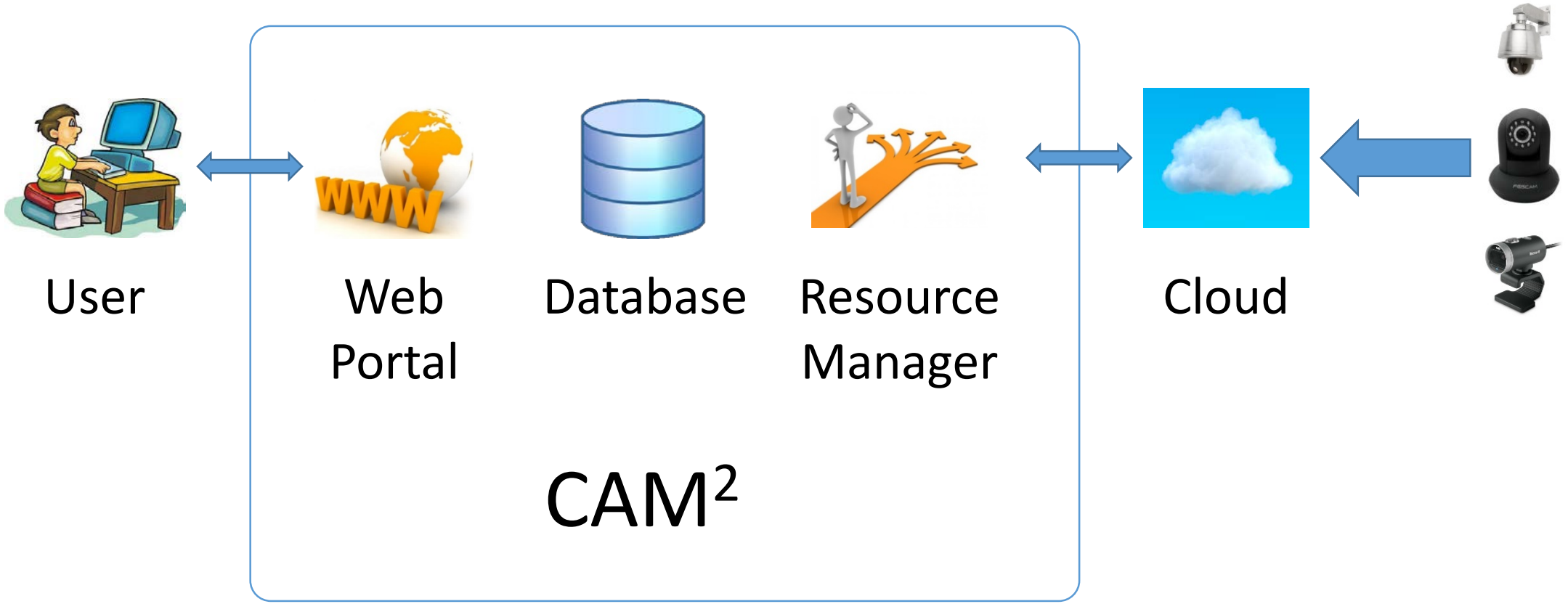


Multimedia Content Problems

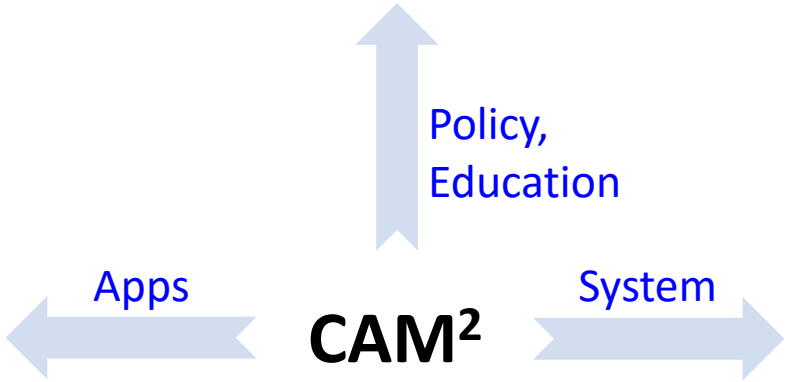
Contributions

- The Architecture of CAM^2
- The Making of CAM^2
- CAM^2 Challenges
  - Camera Discovery
  - Resource Management
- Future Applications of CAM^2

The Architecture of CAM^2



The Making of CAM^2



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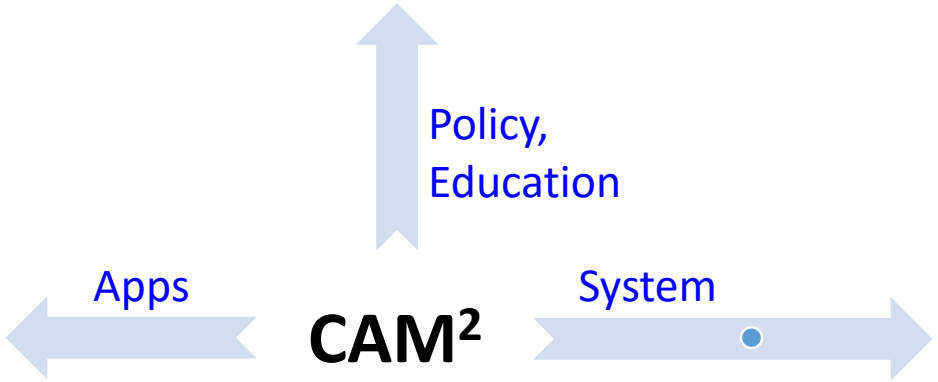

 2.7 Million Images

 1274 Cameras

 3 Hours at 0.2 FPS

 141 GB

 Average Resolution: 768 × 576

 Motion Estimation

 15 Cloud Instances

[1] **A. S. Kaseb**, E. Berry, Y. Koh, A. Mohan, W. Chen, H. Li, Y.-H. Lu, and E. J. Delp. A system for large-scale analysis of distributed cameras. In *IEEE Global Conference on Signal and Information Processing*, 2014.

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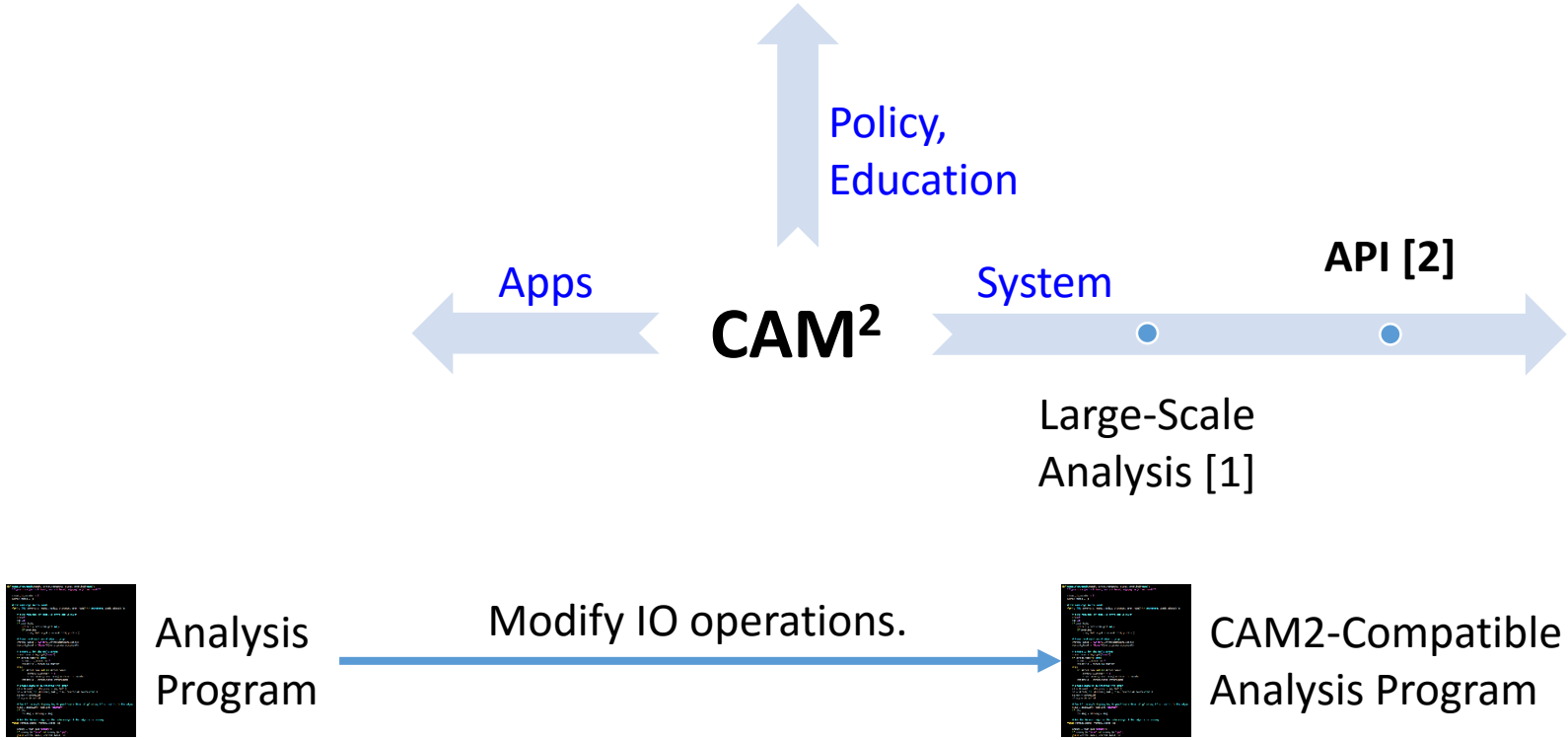

[2] **A. S. Kaseb**, E. Berry, E. Rozolis, K. McNulty, S. Bontrager, Y. Koh, Y.-H. Lu, and E. J. Delp. An interactive web-based system for large-scale analysis of distributed cameras. In *Imaging and Multimedia Analytics in a Web and Mobile World*, 2015.

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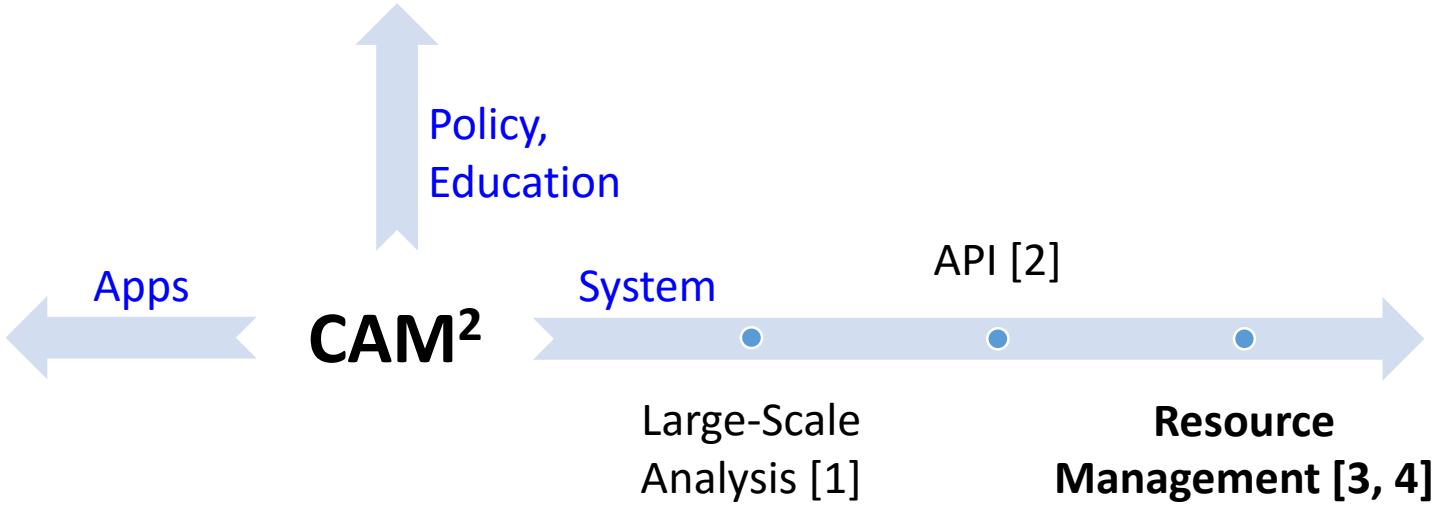

Resource Allocation Resource Scaling Amazon EC2 Microsoft Azure

5.5 Million Images 1026 Cameras 6 Hours 260 GB 13% Cost Reduction

[3] W. Chen, Y.-H. Lu, and T. J. Hacker. Adaptive cloud resource allocation for analysing many video streams. In *IEEE International Conference on Cloud Computing Technology and Science*, 2015.

[4] **A. S. Kaseb**, A. Mohan, and Y.-H. Lu. Cloud resource management for image and video analysis of big data from network cameras. In *International Conference on Cloud Computing and Big Data*, 2015.

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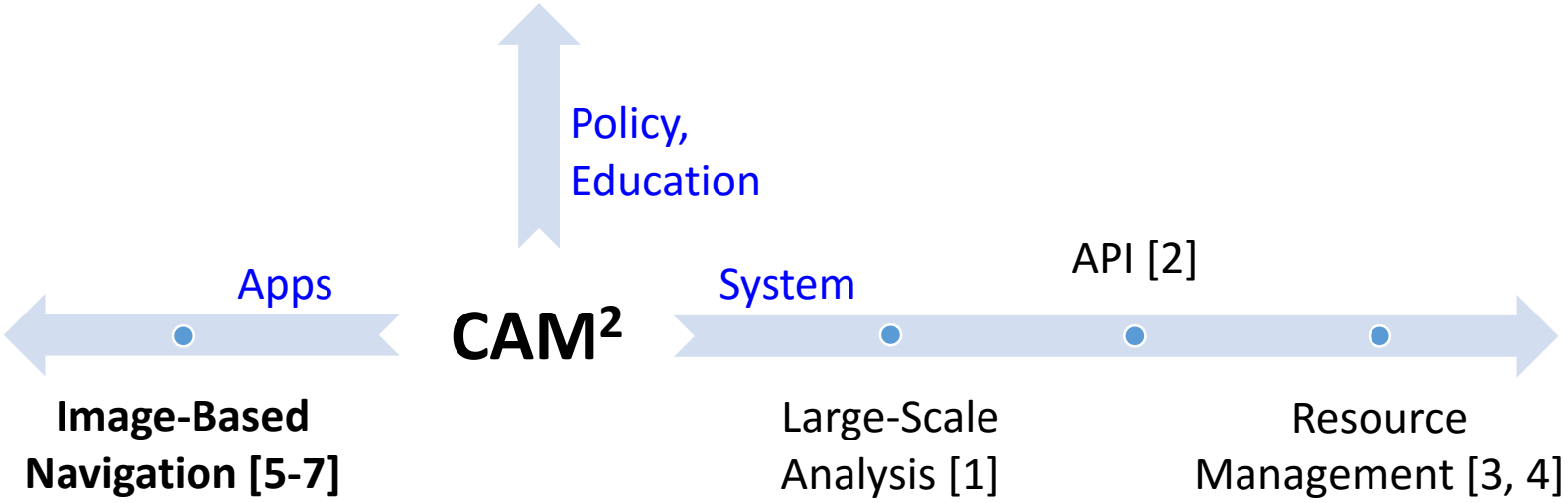

[5] Y.-H. Lu and E. J. Delp. An Overview of Problems in Image-Based Location Awareness and Navigation. In *Visual Communications and Image Processing*, pages 102–109, 2004.

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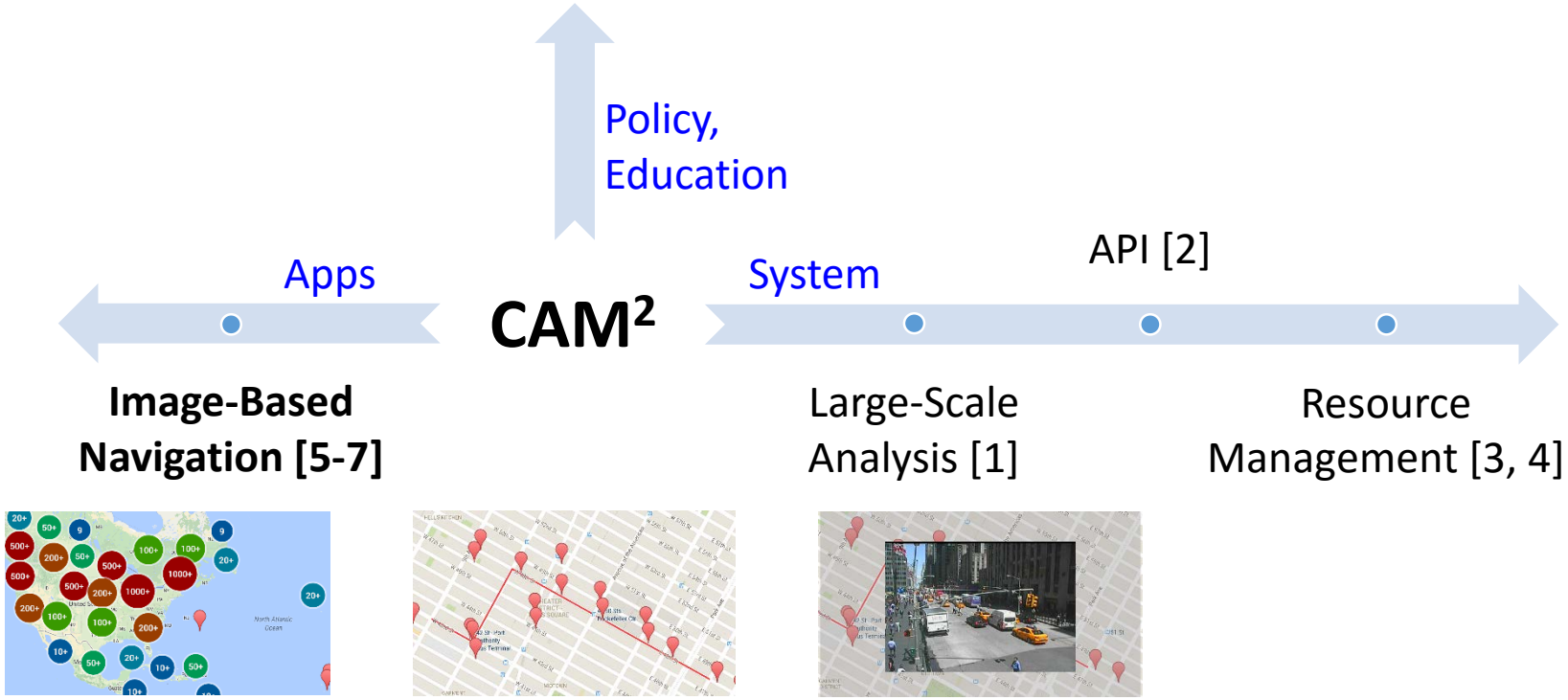
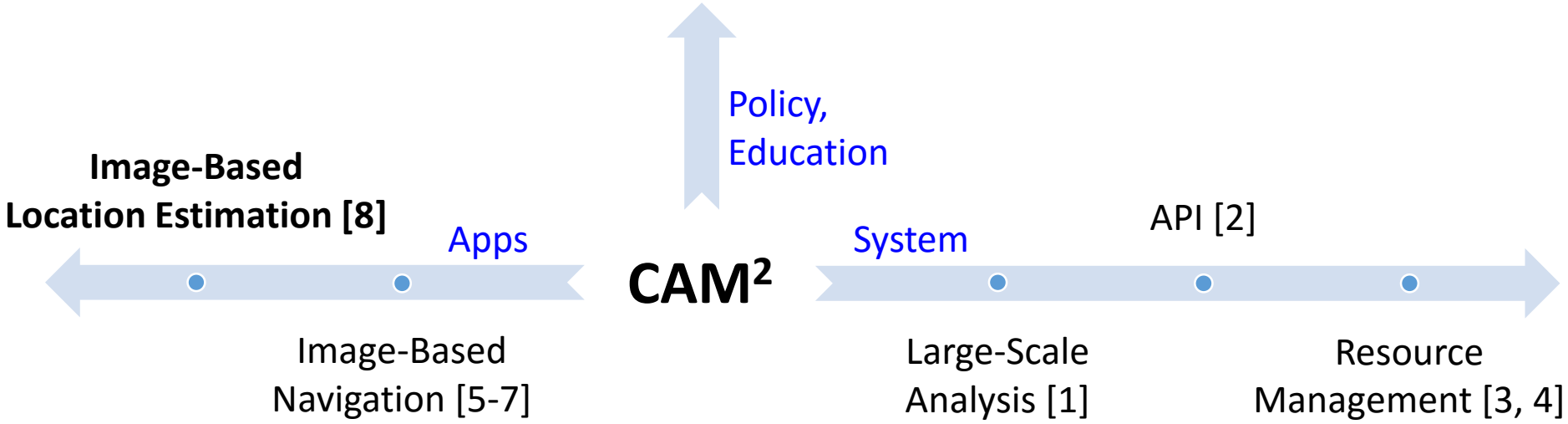


[6] **A. S. Kaseb**, W. Chen, G. Gingade, and Y.-H. Lu. Worldview and route planning using live public cameras. In *Imaging and Multimedia Analytics in a Web and Mobile World*, 2015.

[7] S. M. I. Alam, S. Fahmy, and Y.-H. Lu. LiTMaS: Live road Traffic Maps for Smartphones. In *IEEE Workshop on Video Everywhere*, 2015.

The Making of CAM^2



[8] J. Choe, T. Pramoun, T. Amornraksa, Y.-H. Lu, and E. J. Delp. Image-Based Geographical Location Estimation Using Web Cameras. In *Southwest Symposium on Image Analysis and Interpretation*, pages 73–76, 2014.

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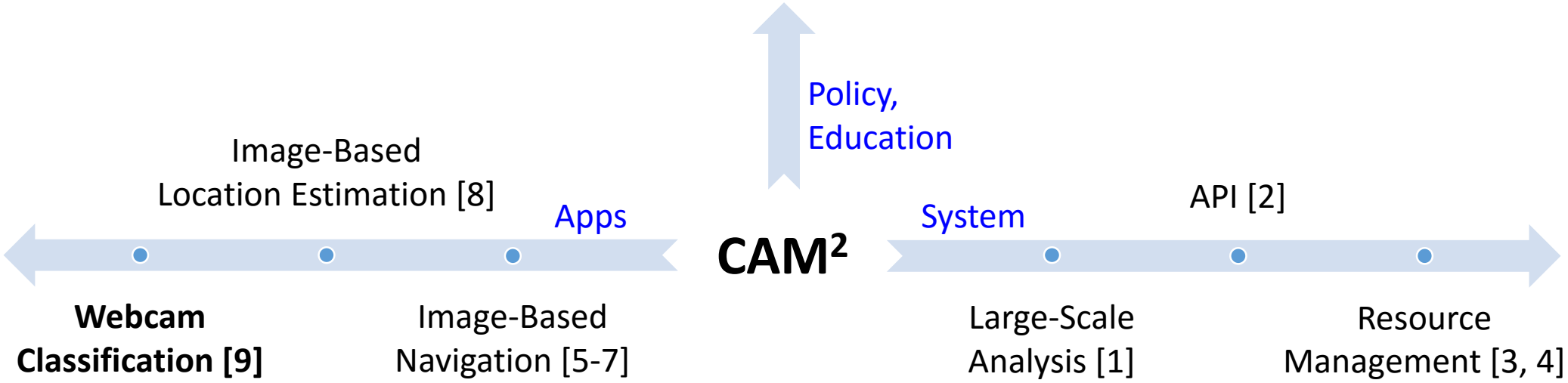


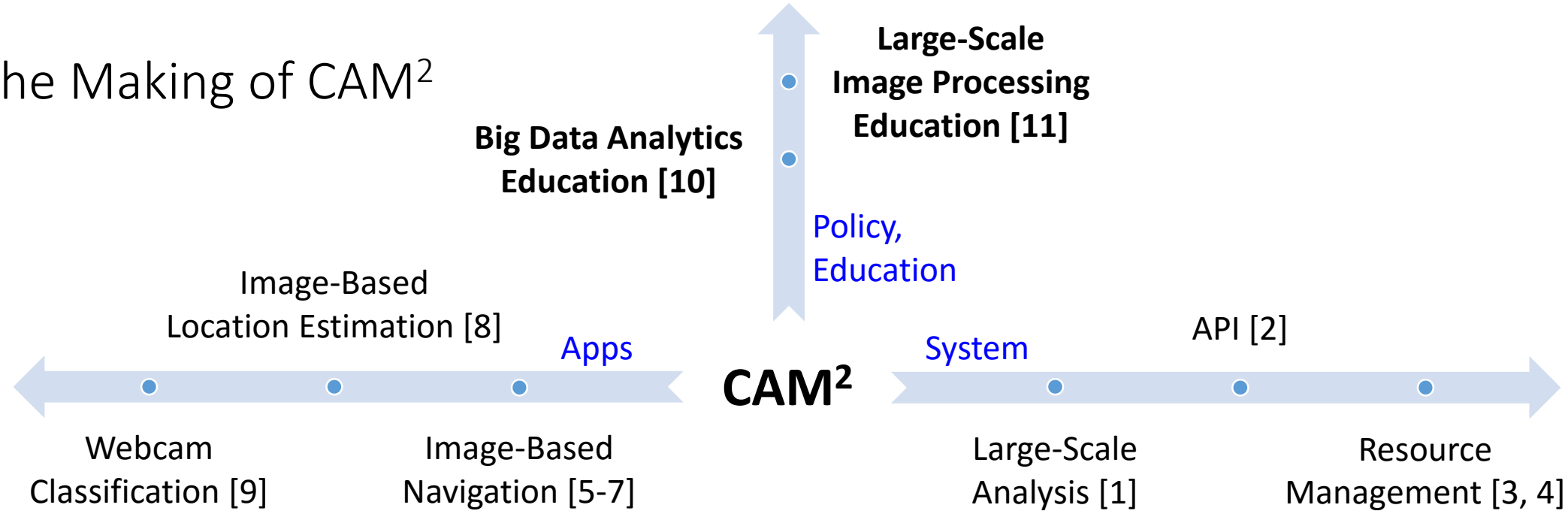
 Indoor vs Outdoor

 People vs No People

 94% Accuracy

[9] T. Pramoun, J. Choe, H. Li, Q. Chen, T. Amornraksa, Y.-H. Lu, and E. J. Delp. Webcam classification using simple features. In *Computational Imaging*, 2015.

The Making of CAM^2



[10] T. J. Hacker and Y.-H. Lu. An instructional cloud-based testbed for image and video analytics. In *Emerging Issues in Cloud Workshop of CloudCom*, 2014.

[11] W.-T. Su, K. McNulty, and Y.-H. Lu. Teaching large-scale image processing over worldwide network cameras. In *IEEE International Conference on Digital Signal Processing*, 2015.

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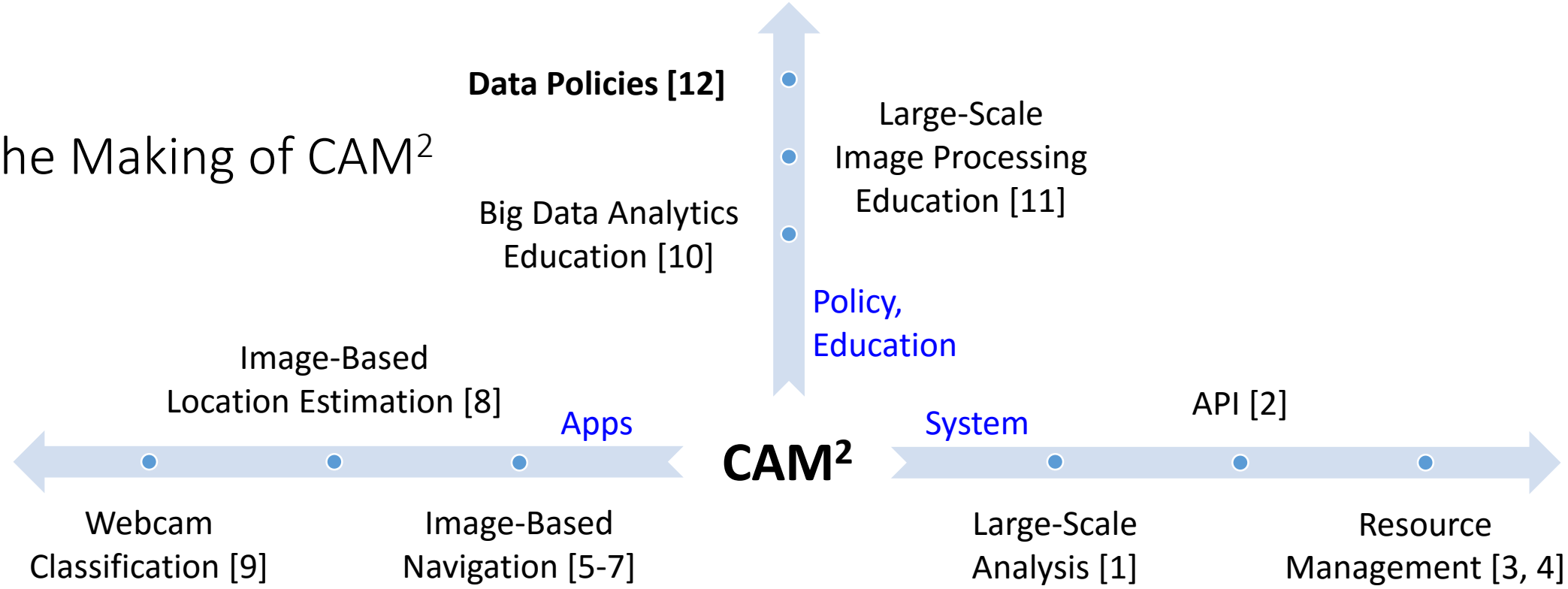
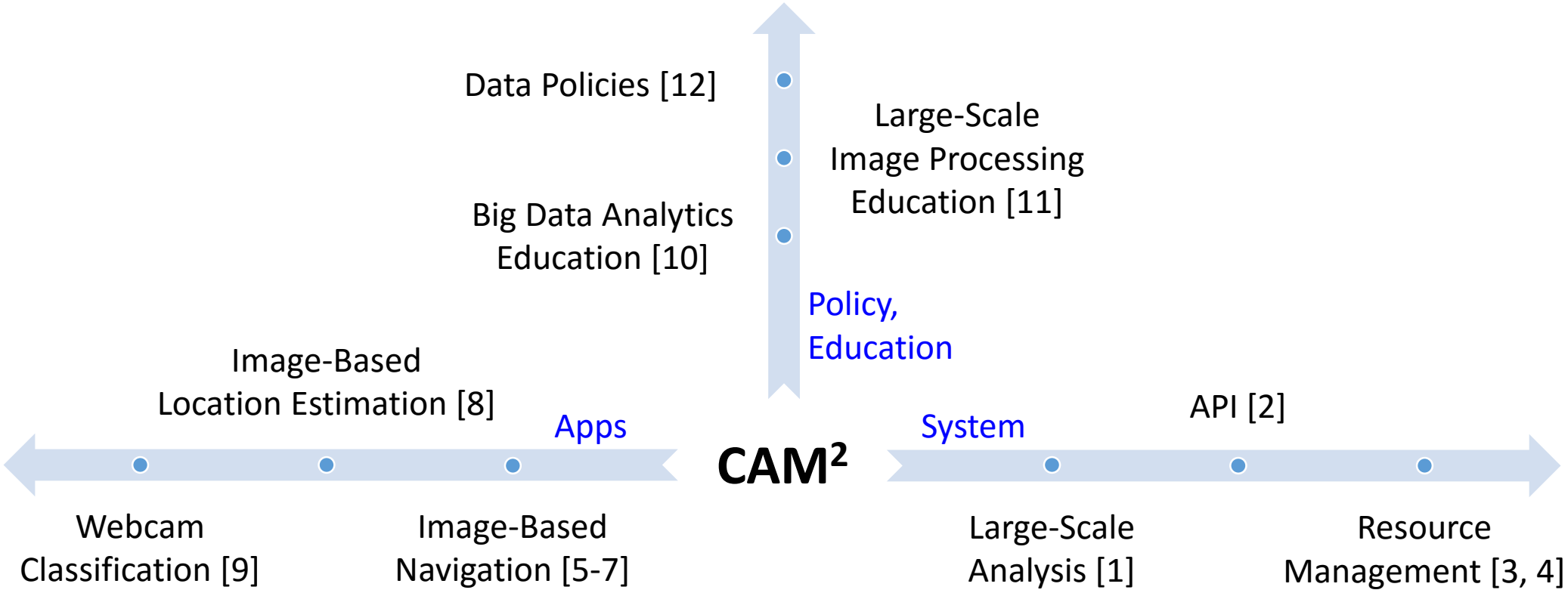
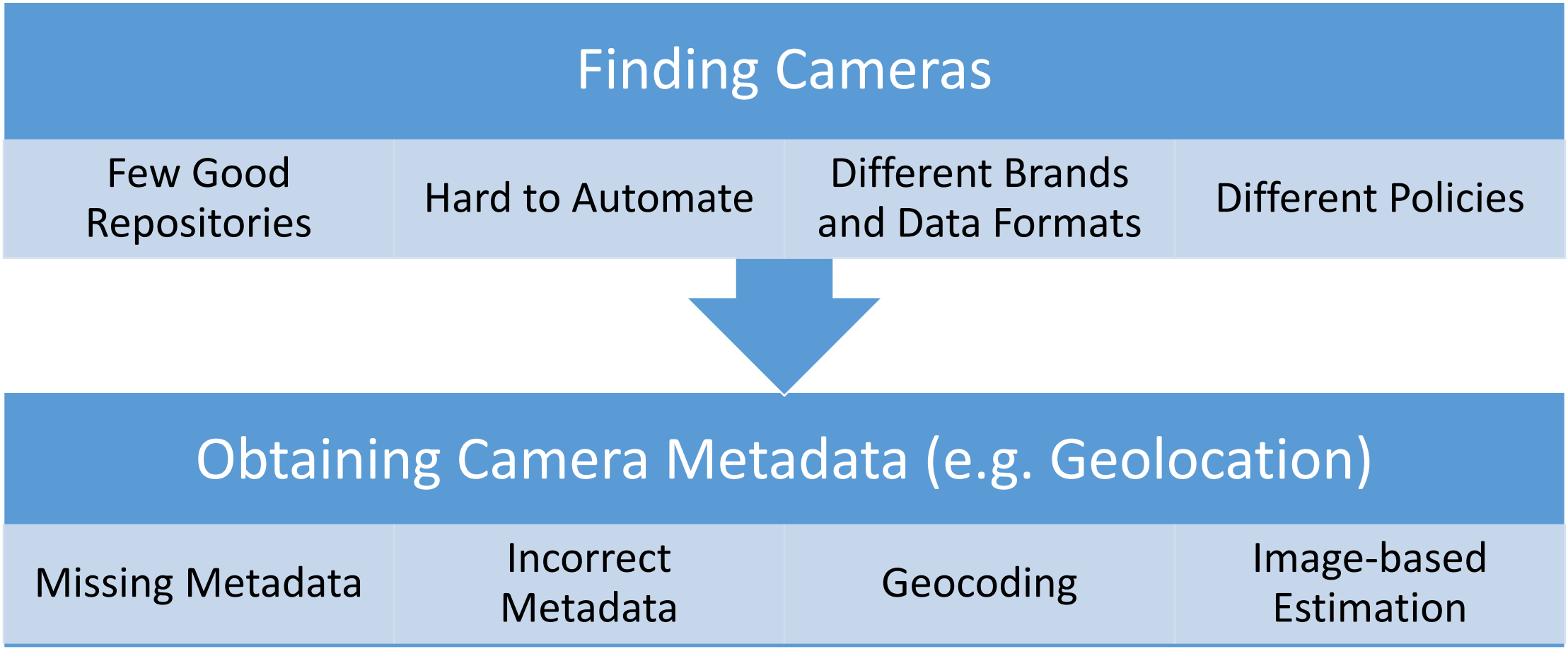


[12] L. C. Pouchard, M. S. Nelson, and Y.-H. Lu. Comparing policies for open data from publicly accessible international sources. In *Annual Conference International Association for Social Science Information Services & Technology*, 2015.

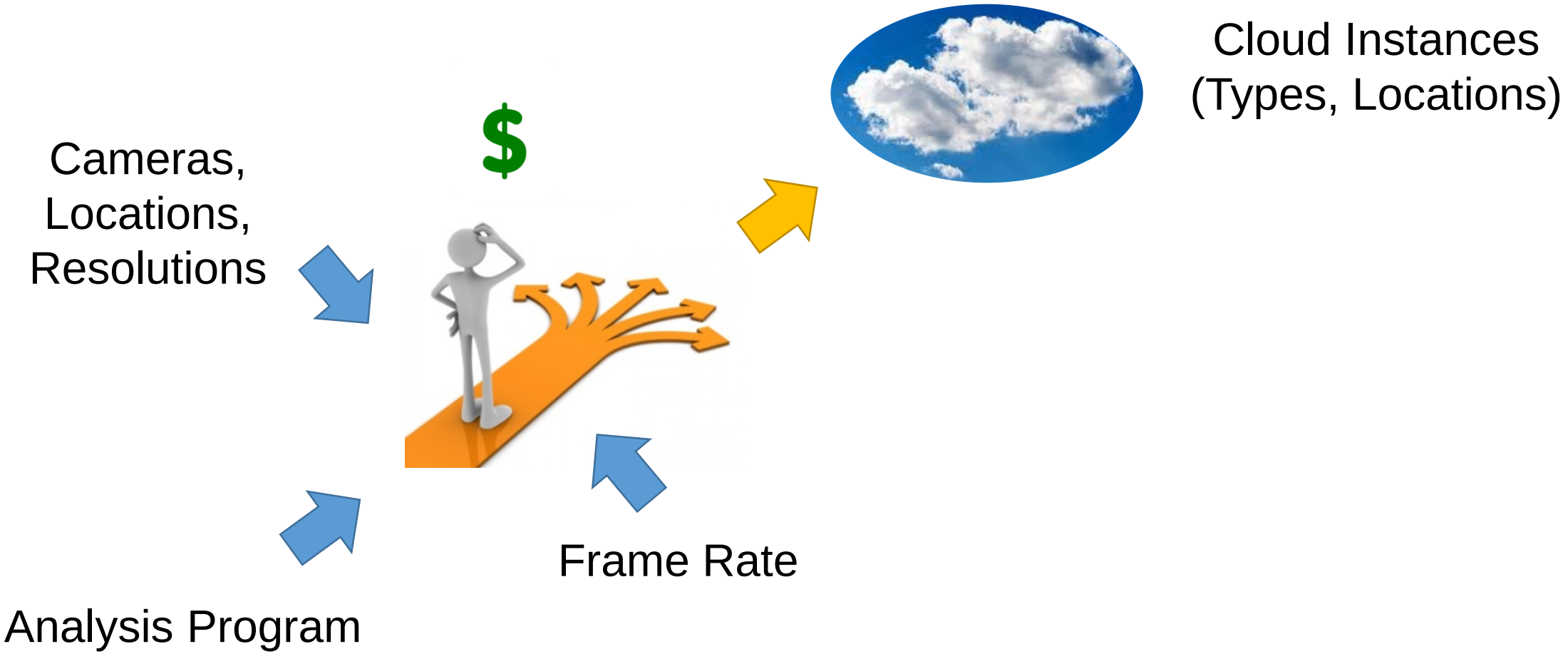
The Making of CAM^2



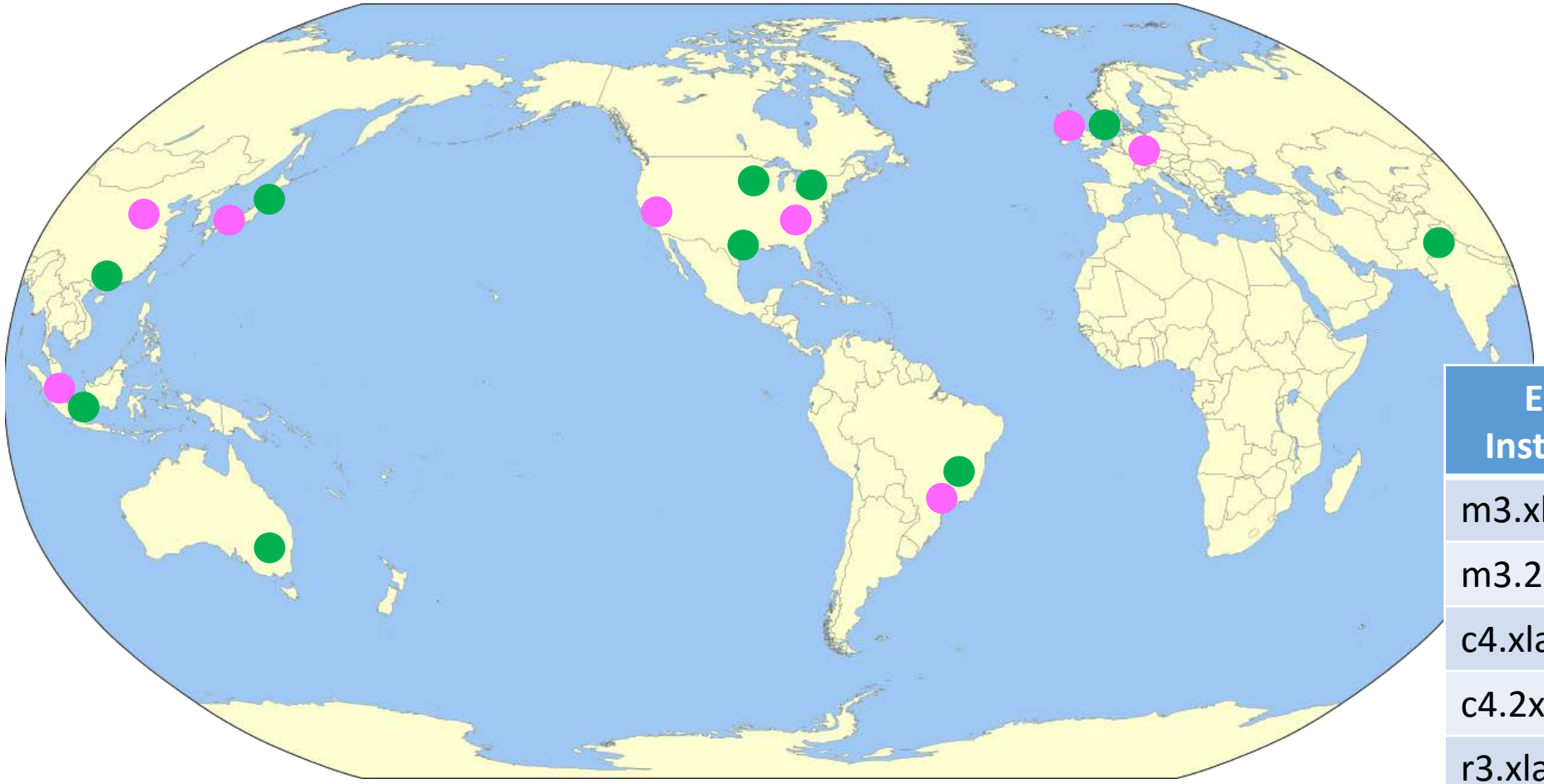
Challenges of Camera Discovery



Challenges of Resource Management



Which cloud instances to choose?

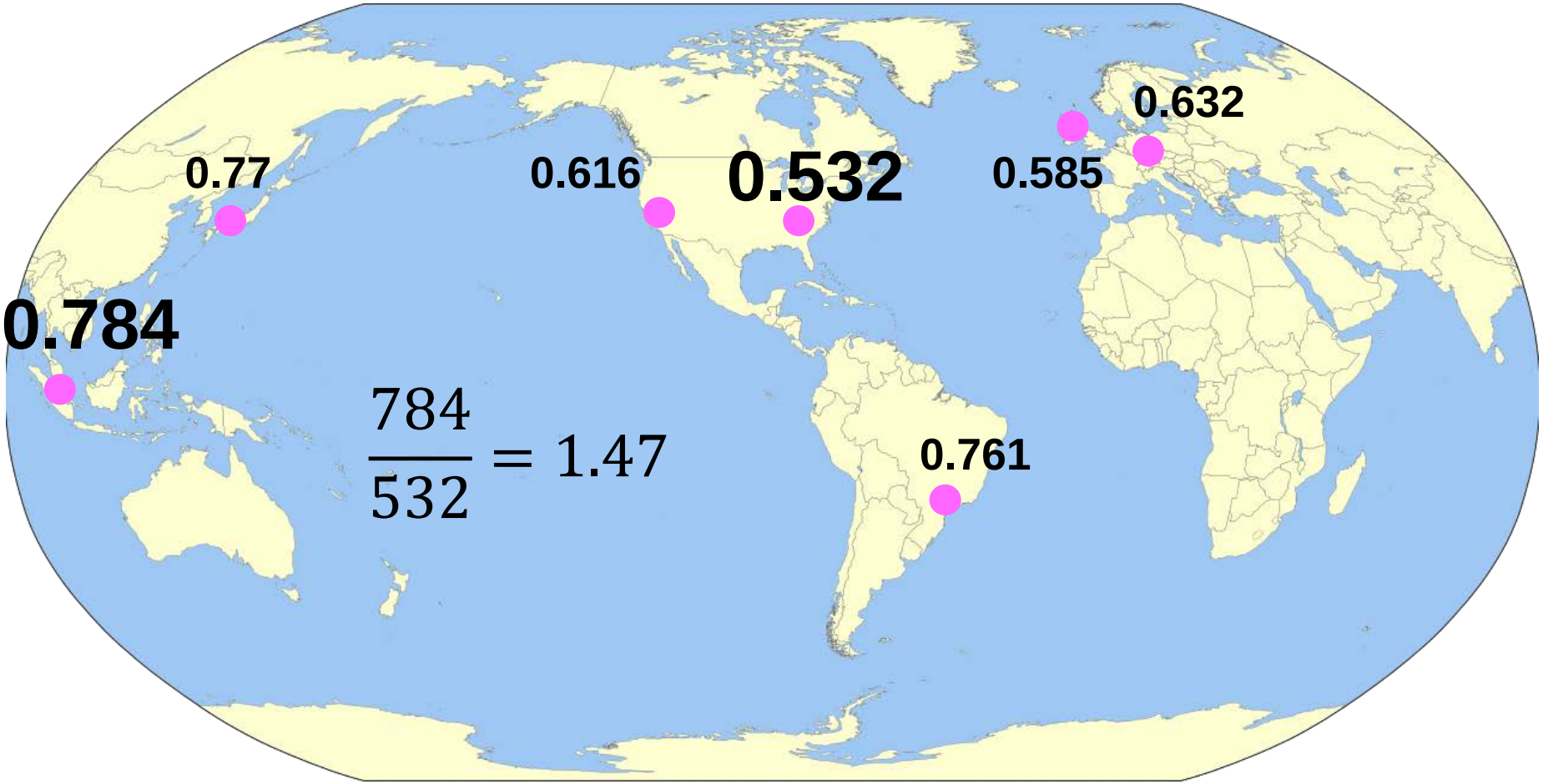


Amazon EC2

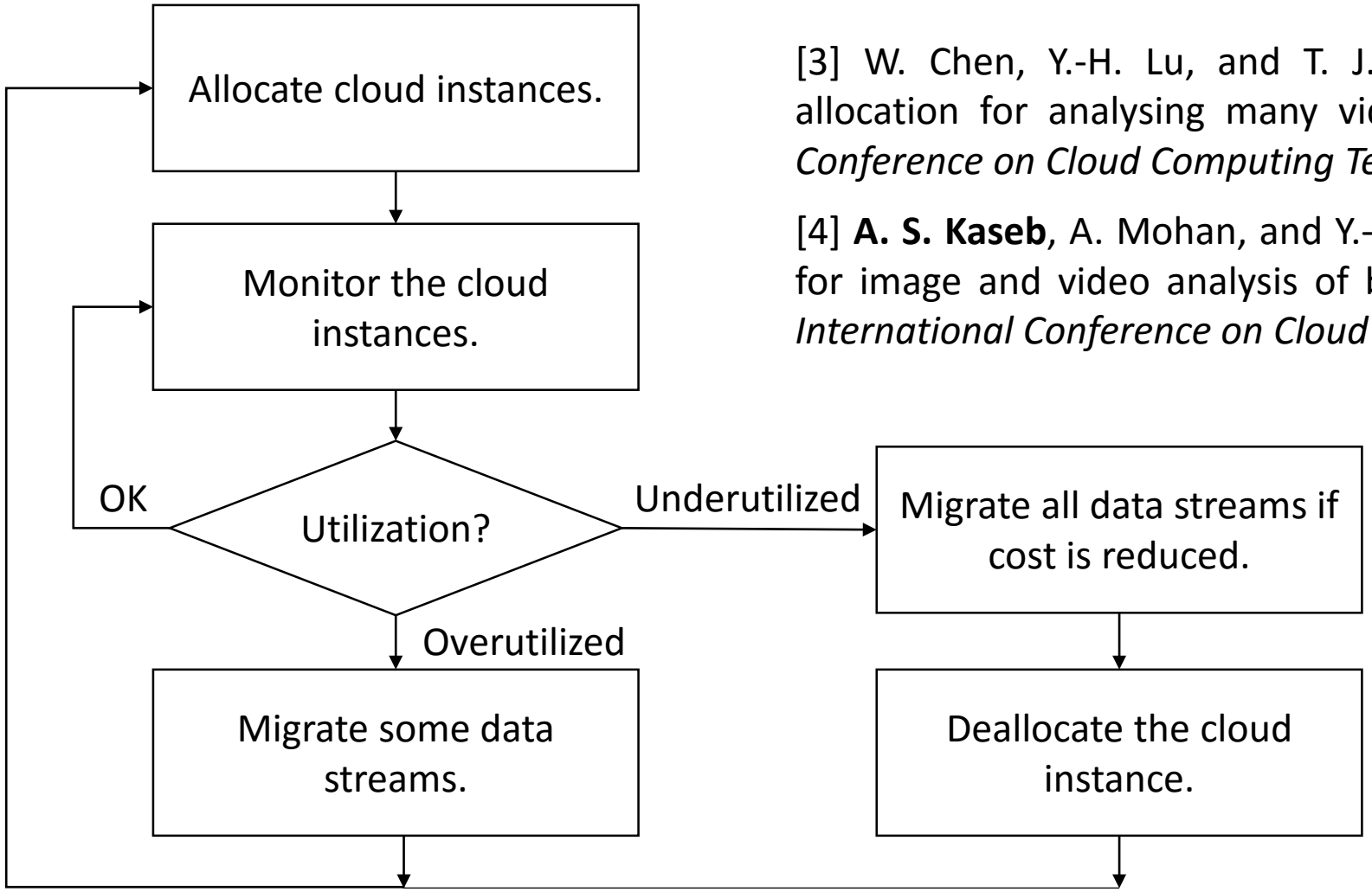
Microsoft Azure

EC2 Instance	Cores	Memory (GB)	Hourly Price
m3.xlarge	4	15.0	$0.266
m3.2xlarge	8	30.0	$0.532
c4.xlarge	4	7.5	$0.220
c4.2xlarge	8	15.0	$0.441
r3.xlarge	4	30.5	$0.350
r3.2xlarge	8	61.0	$0.700

Cloud Pricing ($/hour, m3.2xlarge: 8 cores, 30GB)



Resource Management



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[4] **A. S. Kaseb**, A. Mohan, and Y.-H. Lu. Cloud resource management for image and video analysis of big data from network cameras. In *International Conference on Cloud Computing and Big Data*, 2015.

Future Applications of CAM^2

Few Cameras

- Wildlife Observation

- Air Quality Monitoring

- Volcano Monitoring

More Cameras

- Traffic Monitoring

- Event Watching

- Resorts, Malls, Restaurants

A Lot of Cameras

- Real-Time Virtual Tours
- Real-Time Image-Based Navigation
- More…

Conclusion

- The Architecture of CAM^2
- The Making of CAM^2
  - System, Apps, and Policy and Education
- CAM^2 Challenges
  - Camera Discovery
  - Resource Management
- Future Applications of CAM^2
  - Few Cameras, More Cameras, A Lot of Cameras
- Users and Collaborators
  - Register at http://cam2.ecn.purdue.edu